MOTOROLA

1301 E. Algonquin Rd.
Schaumburg, IL 60196

From: Rich Comroe
Chairman, TR8.10
Telephone: (847) 576-63·
FAX: (847) 538-3282

DOCKET FILE COPY ORIGINAL

Thursday, January 16, 1997

William F. Caton, Secretary
Federal Communications Commission
Room 222
1919 M Street N.W.
Washington, D.C. 20554

Dear Mr. Secretary,

I was cited in the Nevada reply comments on the FCC Notice of Proposed Rule Making (NPRM) 96-86. Attached for the record is my response to that citation by that commentor.

Sincerely,

Dr. Richard A. Comroe
Motorola, Inc.
Chairman, TIA TR-8.10

enclosures

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MOTOROLA

1301 E. Algonquin Rd.
Schaumburg, IL 60196

From: Rich Comroe
Chairman, TR8.10
Telephone: (847) 576-6343
FAX: (847) 538-3282

Date: January 16, 1997

To: Nevada Department of Transportation
Telecommunications Division

Subject: Reply Comments to Federal Communications Commission NPRM Docket No.96-86

Summary

Within the NEVADA DEPARTMENT OF TRANSPORTATION's REPLY COMMENTS TO FEDERAL COMMUNICATIONS COMMISSION NPRM DOCKET NO.96-86, August 30, 1996 you take note of the APCO Project 25 capability to permit feature enhancement to a Project 25 system citing my APCO Bulletin article reference as evidence. As the cited author, I can state that the comment is not properly connected with the quotation, and more fundamentally appears to reflect a lack of understanding of the referenced topic by the comment author.

- It is incorrect to automatically equate Project 25 feature enhancement with increased spectral demand.
- Further, feature enhancements as defined in the quotation does not contravene the interests of the users ... on the contrary, it was explicitly requested by the users.

I encourage the Nevada DOT (NDOT) to participate in the Public Safety Industry activity to generate a useful standard which serves their needs. This activity called Project 25 has been going on for some time. The task-group records show no active participation by Nevada DOT on the Project 25 working committees, specifically the Common Air Interface committees, the Radio Data committees, System committees, or Trunking committees where I have personally spent my efforts. It is difficult for users who don't participate to appreciate the collective beneficial nature of the standard (as demonstrated from the apparent misunderstanding of the user benefit through feature extension -- see below). Further, and just as important, the project suffers through the absence of the specific user's perspective which the Nevada DOT could bring to the process.

Discussion

Page 10 of the NDOT comments contains the following:

> "1. In a technical publication by APCO 25[1] regarding a common air interface, it states, 'Each RF-subsystem manufacturer, however, may augment the basic feature set to include new features which are *supported only on that manufacturer's* mobiles and portables. ***Regarding this issue, it is our viewpoint that requests by APCO to the FCC for more spectrum to support public safety for interoperability, and how public safety needs this spectrum for technologies which support new features and applications, and then adopt a position which can allow these augmented features to become proprietary to a particular manufacturers mobiles and portables is not in the interest of either industry or the user who wish to obtain maximum application from any product on the system. This is not a standard.***
>
> [1] Article by Richard A. Comroe, APCO 25-Demonstrating the Power, Potential and Benefit of a Standard, August 1996 APCO Bulletin."

For your reference, I have included a copy of the cited article from the APCO Bulletin. As the author cited, I offer this explanation in attempt to correct what I perceive as an erroneous understanding of the citation. Specifically you note 2 points in regards to the reference:

1) That permitting feature extension is somehow not in the interest of the industry or users, and
2) that permitting Project 25 to provide feature extension is somehow contradictory to the request of public safety to the FCC for additional spectrum for new features.

Point 1

What is feature enhancement? There are two forms of feature enhancement, features invented after the standard is completed, and unique features supported by only a specific manufacturer (which are not included in the set of user required features formulated into the standard.) For example, it could be as simple as the addition of a button to NDOT radios to perform some purpose not provided by the standard, but uniquely meaningful to NDOT.

No standard could ever hope to embody every optional feature ever defined; desired by every possible user; or for every conceivable scenario. What it does include is a rich collection of features and capability, which can be employed to serve a wide variety of applications.

Feature enhancement is the ability of a Project 25 system to include standard features, optional features, and features not specified by the standard. This was considered so important to the public safety community that this was actually explicitly requested by the committee of public safety users and is a fundamental requirement for Project 25. A copy of the Project 25 User Requirements is also attached, and the requirement specific to this issue is cited here:

> *"User Requirement #18.*
>
> *The system shall allow for continued enhancement of standardized functions and features so that the system can grow with user needs. Further, a standard method shall be specified for segmenting non-standard (or potentially future-standard), value added features between manufacturers to safeguard from un-intentional interaction between radios of different manufacturers sub-systems."*

If Project 25 had not adopted such a user requirement there would be two alternatives left for users to meet their unique requirements not accomodated by the standard~~;~~. ~~N~~neither of these alternatives appears to be in the best interests of the users. In one alternative any feature not explicitly provided by a standard could be considered unavailable, and any such feature deemed necessary in a particular application could result in leaving the user high-and-dry. In the other alternative any feature not explicitly provided by a standard could be added to a standard system by any manufacturer, putting the user at risk because feature enhancements are wholly uncoordinated between manufacturers. Let there be no mistake on this ... uncoordinated enhancements provided by more than one manufacturer can result in not just incompatibility, but potentially disastrous consequences for the user. No-one can completely predict what might happen.

Since Project 25 thought through this issue in advance, the Project 25 user is guaranteed that enhanced features can be integrated into an otherwise standard system. Also, the user is not restricted to purchasing enhanced features from a single manufacturer. As a result, the user is guaranteed that enhanced features from different manufacturers are comfortably safe from unintentional interaction. This requirement and definition is not found in ANY other Land Mobile Standard for public safety.

Do feature enhancements remain proprietary indefinitely? That is for the users to decide. Some features only thought to be of value to a select market segment may remain proprietary indefinitely. Others, such as any new feature which becomes desirable to a significant segment of the public safety market, can always be added to the core feature set at any future date. What feature, and when, is yet to be known, as we are talking about the future. This is exactly akin to the Project 25 Phase II process where activity to add a set of planned enhancements to the standard is already underway.

Point 2

Is providing for new features somehow inconsistent with public safety expressing the need for additional spectrum? As a participant in the Project 25 process and as an author of significant portions of the PSWAC Technology report I find no issue here. The Nevada DOT comment on my citation suggests some connection between the new features and applications which will require additional spectrum, and the new features which might conceivably be added to a Project 25 standard system.

A new feature or application might be as trivial as adding a signaling button for some specific meaning with little impact ~~to~~ upon spectrum demand. Today one user might find value in such a feature and obtain it as a manufacturer specific extension to an otherwise standard Project 25 system. Tomorrow, that specific signaling button might appeal to sufficient users as to result in user initiated action to add the feature enhancement to the core standard.

Other types of features or applications (such as AVL) may have little impact to system technology by way of their functionality such that they may be potentially added to the standard with little effort. However their effect on the amount of spectrum required depends upon their use. For example, limited use of AVL is certainly within the capability of available technology, although application can readily result in demand for additional channels to accommodate a larger-number of vehicles involved or the frequency of location updates.

Advanced technology types of features or applications (such as high capacity data, or video) can easily be differentiated as those that create significant impact to spectrum required. These were recognized by PSWAC and specifically used in the modeling process to determine total Public Safety spectrum requirements through the year 2010.

Conclusions

The public safety users determined that their standard, Project 25, should have the ability to add enhancements and so stated in their user requirements document.

Potential Manufacturer enhancements do not invalidate the Project 25 standard (similar to the variety of VCR's which all play the same standard video tapes but have a wide variety of enhancements to attract users.)

PSWAC deliberations were technology neutral and did consider the impact of many new capabilities needed by public safety users, some of which may be supported by the Project 25 standard.

We invite and look forward to NDOT, as an interested user, to participate in the development and enhancement of standards which can affect their communications systems.

Regards,

Dr. Richard A. Comroe
Motorola, Inc.
Chairman, TIA TR-8.10

cc William F. Caton, Secretary, Federal Communications Commission
Marilyn Ward, APCO International
Craig Jorgensen, Project Director, APCO Project 25

Chairman of three APCO 25 project study units outlines standards-based interoperability

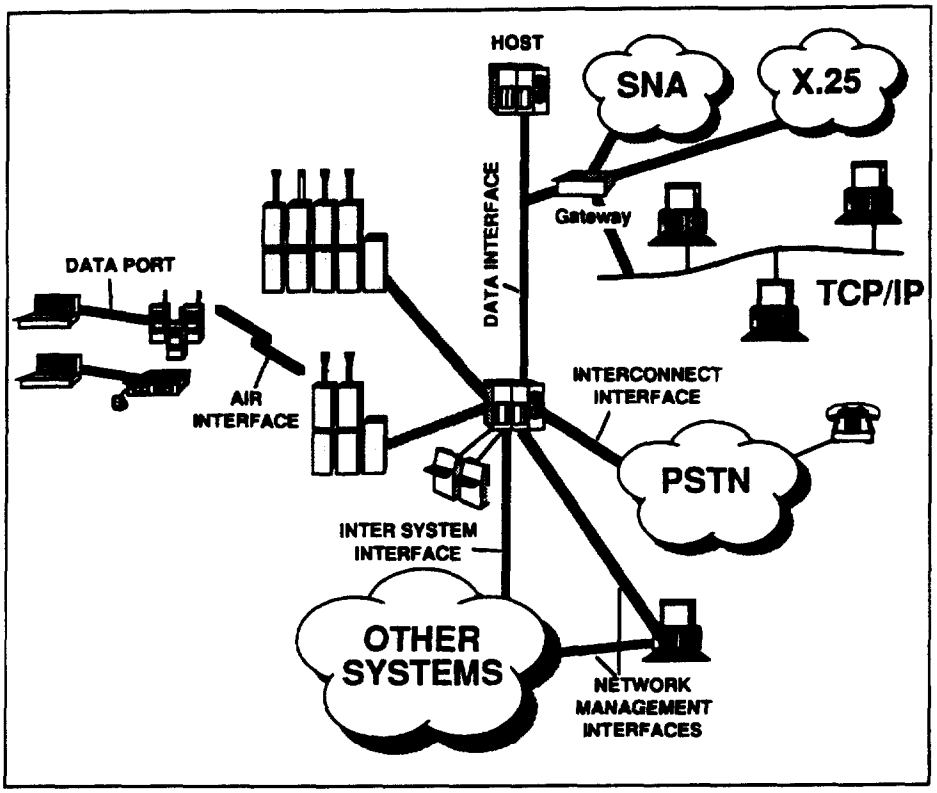
By Richard A. Comroe

APCO 25 — Demonstrating the Power, Potential and Benefit of a Standard

This article presents a future vision of land mobile radio interoperability with special focus on APCO 25-based systems. As described, land mobile radio communications systems are already on a forward migration path that will lead to communications interoperability.

The necessary precursor to interoperability is the development of emerging technology based on user-driven standards. A well-conceived standard allows users a choice of many interoperable products from various sources with a wide range of competing features. This article describes the planned migration path through standard land mobile radio systems, and then provides a vision of the resulting communications interoperability.

The migration toward radio system standards has been likened to the era of open architecture for computers, specifically the emergence of the IBM PC as an open standard in the home-computer industry. This important event not only paved the way for an era of compatible hardware and software products from an uncountable number of manufacturers, but also formed a bounded path for continued compatible personal computer technology advancements.



APCO 25 standards have defined six open system interfaces for APCO-25 compliant systems, as illustrated in the block diagram. These open interfaces are indicated by black labeled lines. The intent is that equipment on either side of any open interface may be supplied by any manufacturer.

Because of the PC standard, software written for that standard can be used readily on virtually any PC. Further, interworking of software written for the same platform has become a reality.

Business travelers literally can take only an application document on a disk and "find" a computer which can edit, print or fax wherever their business might take them.

The same vision has many elements which hold true for the radio user. Just as in the PC industry analogy, the establishment of a foundational open standard can result in not only compatibility of equipment, but an expanded market of compatible components, accessories, applications and software. An open standard also can define a forward path of compatible system evolution.

We have seen the "step beyond" in the PC industry because it already has happened. However, this step beyond was not clearly evident in the PC industry before it actually occurred. This article attempts to illustrate just such a vision for land mobile radio.

The APCO 25 system is a standard system. This means that APCO 25 standards have defined six open system interfaces for APCO 25-compliant systems, as illustrated in the block diagram (above). These open interfaces are indicated by black labeled lines. The intent is that equipment on either side of any open interface may be supplied by any manufacturer.

Each of these interfaces will be reviewed, one at a time:

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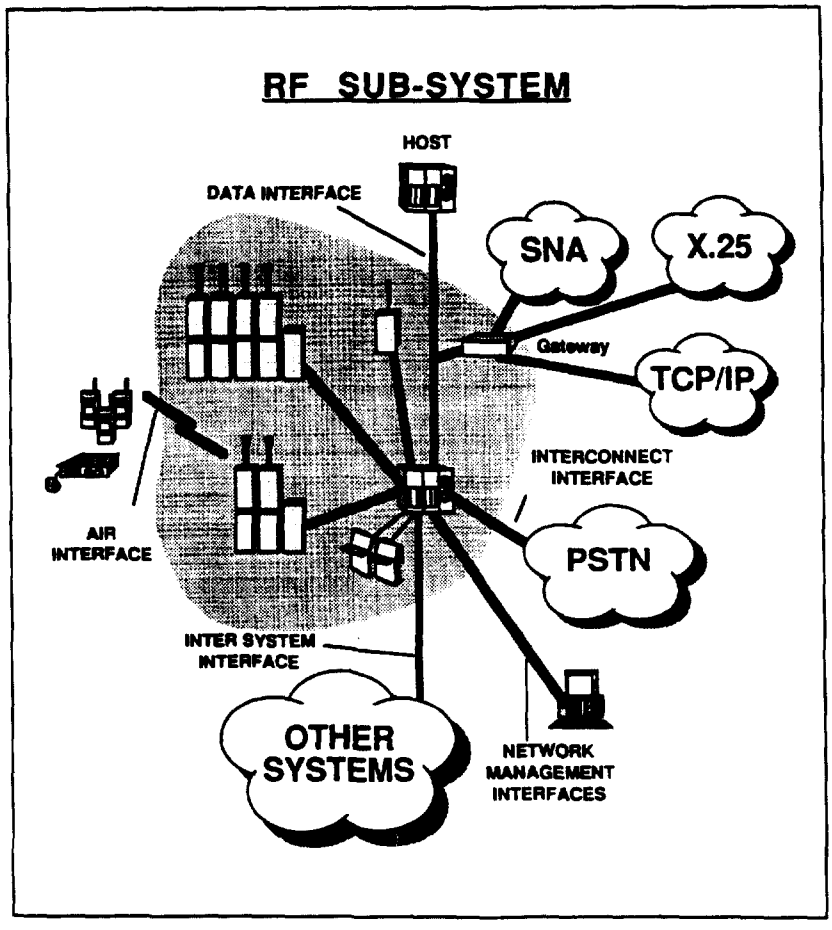

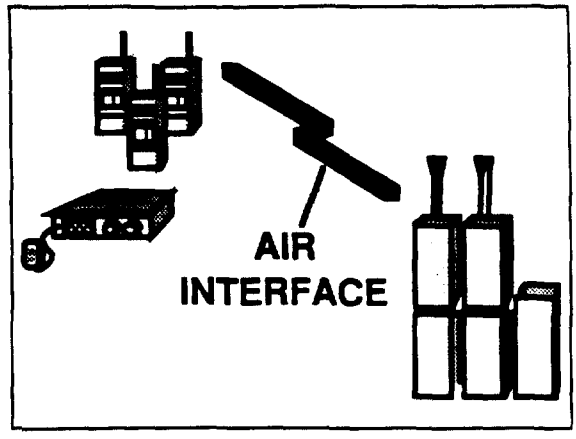

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Common Air Interface

A major accomplishment of the APCO 25 system is the common air interface (CAI). Mobile and portable equipment from any manufacturer have the potential to be freely combined in any APCO 25 system. A base of radio features from any system should work through different manufacturers' radios.

Each RF-subsystem manufacturer, however, may augment the basic feature set to include new features which are supported only on that manufacturer's mobiles and portables.

This new term, "RF subsystem," is defined by the APCO 25 open-system architecture and will become as well known as "DOS" in the new era of compatible APCO 25 systems.

Site equipment is a variable density with the requirement for one common air interface, whether there are multiple stations or only a single station at any site. In APCO 25, terms such as "conventional" and "trunking" might no longer be meaningful distinctions.

RF Subsystem

The RF subsystem (above left) consists of infrastructure, bounded by the five open APCO 25 interfaces and three standard computer network gateway interfaces. It can be composed of any collection of site equipment, be it single station or multiple stations, and single site or multiple sites.

The only requirements are that the station equipment supports the common air interface and optional open RF subsystem interfaces. These become the building blocks for wide-area system construction which will connect with any other equipment or RF subsystems, regardless of configuration.

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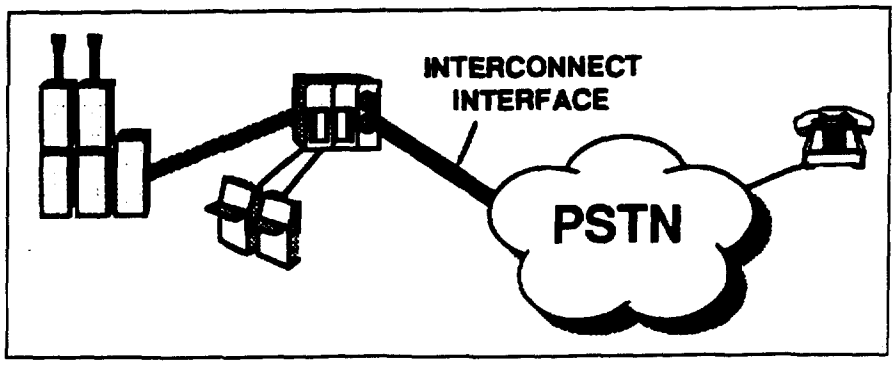
APCO International Members Benefit From APCO International Membership Benefits



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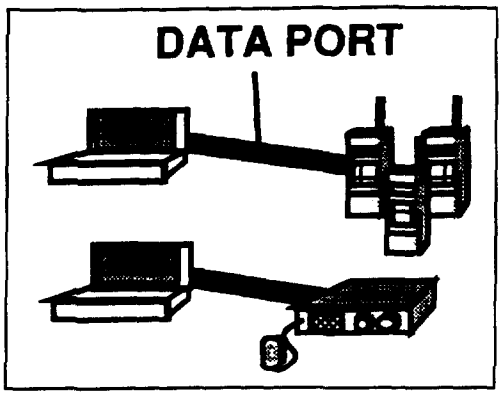
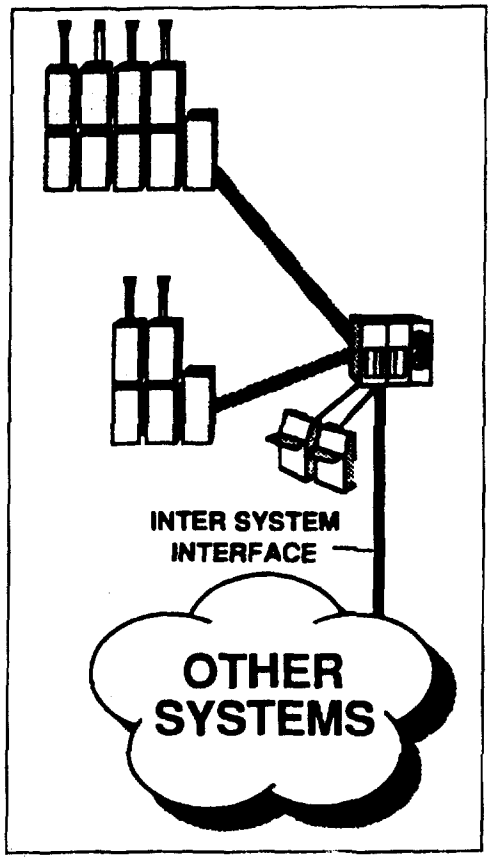
Data Port Interface



Both mobile and portable radios will support a port through which laptop computers, data terminals or peripherals can be connected. Two existing basic alternative standard protocols will be supported on this open interface.

The first corresponds to a circuit service, where the radio looks to the peripheral like a standard AT command set modem service which is then passed transparently to a fixed-circuit interface such as a telephone line.

The second corresponds to a packet service, where the radio supports a standard serial line Internet protocol, or SLIP packet service which is then passed transparently into any fixed IP packet network. The pipe is transparent in the sense that a standard application designed for an IP network or a circuit modem may function without customization on any APCO 25 radio.



Inter-System Interface

This is a key open interface to the RF subsystem because it permits RF subsystems to be interconnected into wide-area networks. Multiple systems may be interconnected to provide very wide-area coverage and roaming, possibly nationwide.

Although a given mobile or portable radio may roam freely only between systems with the standard APCO 25 digital common air interface, the APCO 25 inter-system interface has the potential to bridge a gap even wider, such as between a customer's private radio network and a customer's private telecommunications network.

This interface provides a common meeting place for RF subsystems and RF systems of different technologies (FDMA, TDMA, CDMA), different manufacturers and even different RF bands.

Interconnect Interface

Every APCO 25 RF subsystem optionally may support an open telephone interconnect interface to a telephone network (top left). APCO 25 provides greater opportunity for interface than historical land mobile radio because both analog or ISDN telco interfaces may be employed.

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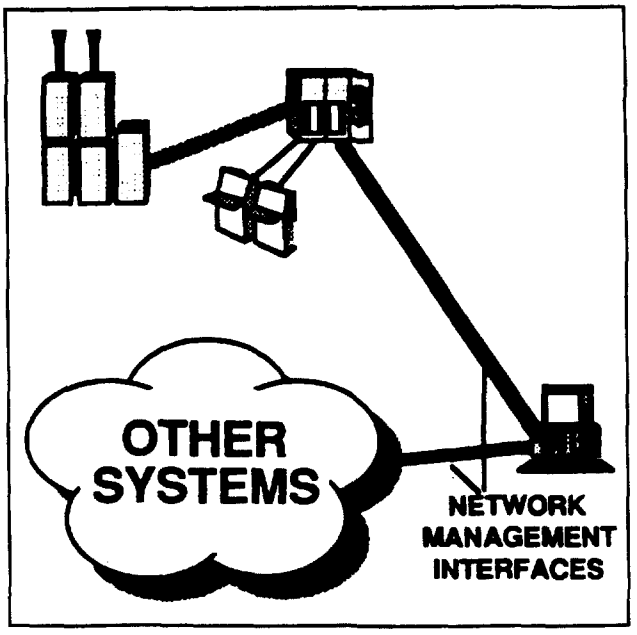
The interconnect interface, along with the open inter-system interface, provides an avenue for future enhancement of functionality within the guidelines of the open standard.

We anticipate future applications to result from the extension of the standards, just as witnessed across the last decade on personal computer equipment.

Network Management Interface

APCO 25 adopted a uniform network management interface to all RF subsystems, regardless of manufacturer.

Within any manufacturer's RF subsystem, all five classic elements of network management must be supported according to a single selected network management scheme.



A network management scheme was selected that will bring with it the ability to manage RF subsystems with available network management system equipment through adoption of the industry standard simple network management protocol, or SNMP.

In addition, a customer's existing network management system, including computer and telecommunications equipment, also may be able to encompass APCO 25 radio systems.

Perhaps the most complex interfaces are those for data host computer and/or network connectivity. A variety of data connectivity is requested in the APCO 25 requirements.

The standard currently supports the connection of a native host computer through an open interface for connecting host computers across an Internet Protocol (IP) network, and has the ability to connect to a dial-up host computer across a switched telephone network.

Of significance is the logical requirement of APCO 25 that supported services must be transparent. Essentially, every radio may support a computing device which is (from the standpoint of an existing application) indistinguishable from one that is connected by a telephone modem or fixed-network.

While radio is different, getting started with data may be as easy as connecting a computer in a vehicle and "logging in" to any host applications already in existence on the network.

Forward Migration

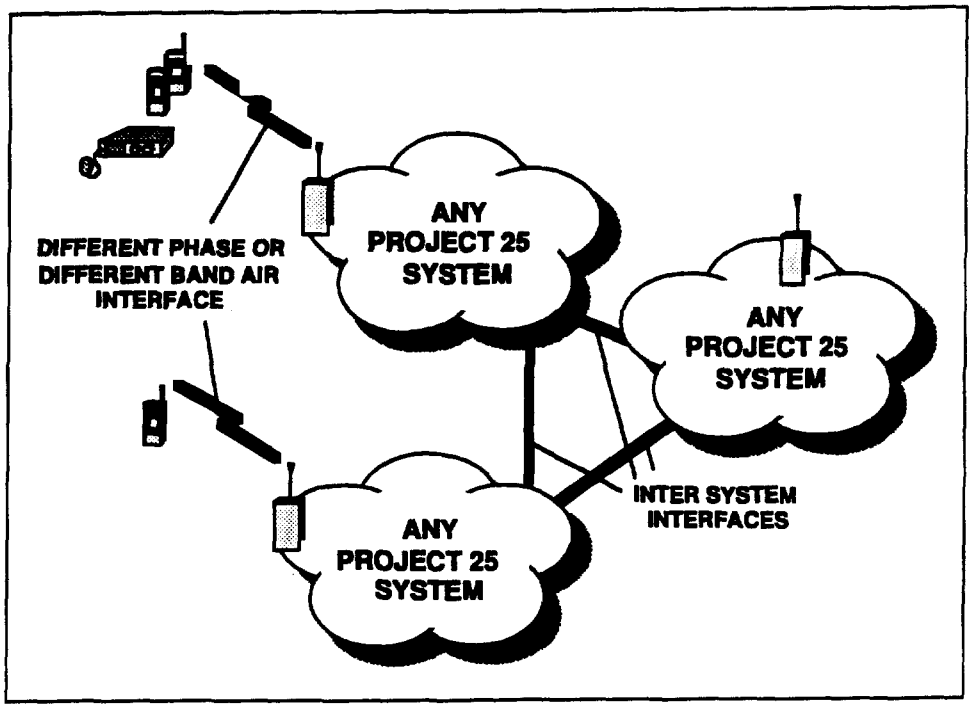
As shown in the diagram, the APCO

25 system is defined by a set of open interfaces and functional suites. It supports a wide range of configurations and services and has hooks for adding additional services. Because of this flexibility it may serve not only the diverse needs of public safety, but also various other markets as well, such as railroad, transportation or utility. This also provides mutual benefit to all through the expanded volume of manufacturing.

Having defined an open system model further provides the opportunity for long term migration to newer technologies. Of the six APCO 25 open interfaces, only one is specific to the air interface. Conversely, five of the six APCO 25 open interfaces are totally independent of the specifics of the current common air interface.

This is extremely significant, and it deserves added emphasis. For example, Phase I defines a 12.5 kHz common air interface. Phase II will define a 6.25 kHz or equivalent common air interface(s). Since all other interfaces remain the same, this means that data applications written to the data port and fixed data interfaces will work on Phase II.

It also means that wide-area systems composed of RF subsystems that support the Phase I common air interface and RF subsystems that support the Phase II common air interface(s) may be freely interconnected through the inter-system interface.



RF subsystems can be integrated into common wide-area radio or data systems even if they support some future phase of the common air interface, or different band RF technology.

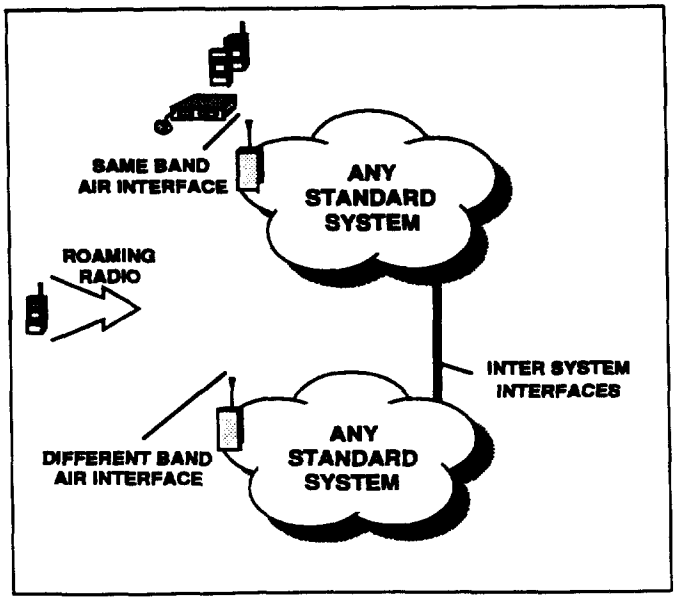
Users of an APCO 25 system can transparently talk to units using a different air interface as long as their respective RF subsystems are connected.

Phase I and Phase II already are defined to differ in RF bandwidth. There is nothing preventing future phases from differing in additional ways, as well. For example,

definition of wide-band data can easily be thought of as just one of any number of potential future phases of the standard.

Just like the PC industry, there is real value to orderly forward migration of a standard. Continuing with the hypothetical wide-band data example, establishing a wide-band data channel capability might be interconnected with pre-existing RF subsystems.

More creatively, additional RF capabilities might also be integrated into the same RF system. Within future trunking systems, channel assignment might define not just frequency of operation, but also the bandwidth of the channel.



Roaming and Interoperability

APCO 25 provides the standard to enable a roaming radio unit to operate in a different system because of the common air interface. The roaming radio can actively seek a compatible common air interface in an RF band within its physical ability to operate. It should be recognized that limitations on roaming exist based upon such hardware-related issues such as band of operation. Compatible systems can be deployed at different RF bands, while any given APCO 25 radio may or may not be capable of operating in more than a single RF band.

Compatible LMR systems will span nearly 1,000 megahertz of spectrum, scattered over four disparate and major segments of RF band. Even within a given phase (such as Phase I), a radio may not be able to work on every Phase I system due to their deployment in different RF bands. However, compatible systems in different RF bands can communicate through the standardization of the other five non-RF interfaces.

However, it is anticipated that RF subsystems will be increasingly interconnected with other RF subsystems. Where interconnected RF subsystems exist at multiple bands, it no longer becomes necessary for an APCO 25-compliant radio to operate at more than a single RF band.

A roaming radio does not need to operate on the same RF band as the destination radio.

It is only necessary that the roaming radio be able to find an RF subsystem on the band it is capable of operating, while the RF subsystem is interconnected with the RF subsystem of the destination radio.

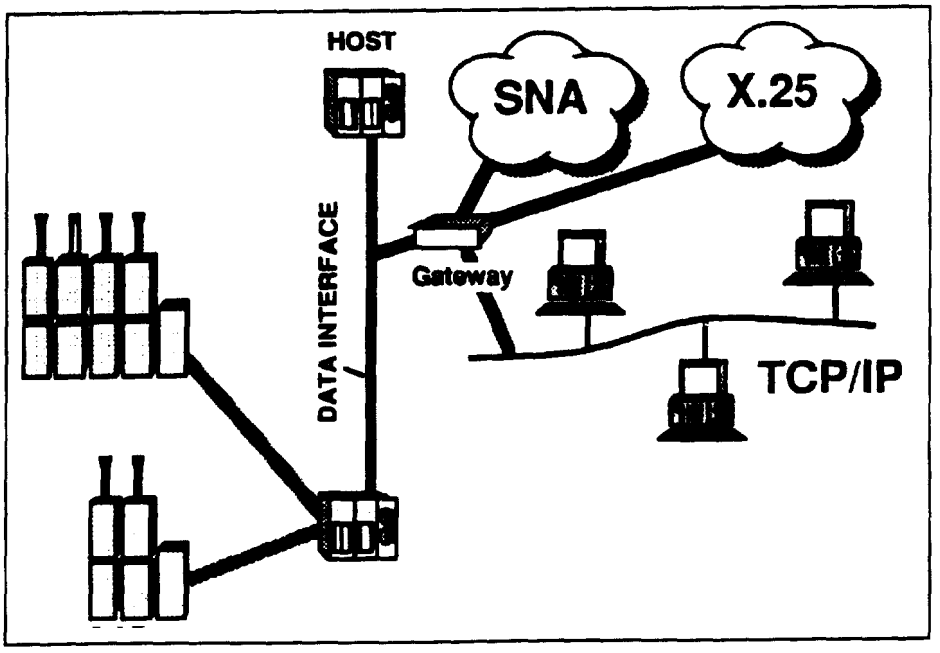
In a fashion identical to cellular deployment, as more APCO 25 subsystems become interconnected, the ability of every APCO 25 radio to intercommunicate and roam also grows directly.

Conclusion

Two years ago, APCO 25 was described in terms of technical direction. Today APCO 25 can be described in terms of technical detail. It has been designed to cover a broad range of configurations with a rich set of services. This results in flexibility.

Now that APCO 25 exists, its future potential can grow beyond the specifics of its current technical specifications. Like the PC, APCO 25 defines a starting point for growth of a new family of standards-compliant products.

Every new telephone installed, or computer on the Internet, expands the capabilities to every other device previously deployed. In this same fashion, APCO 25 can evolve additional value for roaming, networking, interoperability and data. This is the power, potential and benefit of a standard.



About the Author

Dr. Richard Comroe is an associate of Motorola's Science Advisory Board and is a Dan Noble Fellow, Motorola's highest engineering honor.

He is chairman of the APCO 25 Interface Committee's Radio Data Task Group, Trunking Group and TIA TR-8.10 Trunking and Conventional Control Subcommittee. He also formulated the system architectural model used as a reference for the development of APCO 25 standard specifications.

Dr. Comroe joined Motorola in 1974. He has held positions in research as well as data and trunking engineering product development. He holds a master's degree in electrical engineering from the University of Illinois and a doctorate from the Illinois Institute of Technology. He is also an inventor with 30 issued U.S. patents.

Dr. Comroe has been an associate professor with both the Illinois Institute of Technology and Northern Illinois University, where he earned his bachelor's degree. ▲

NEW TECHNOLOGY STANDARDS PROJECT
DIGITAL RADIO TECHNICAL STANDARDS
STATEMENT OF REQUIREMENTS
Thursday August 11, 1994
Adopted by APCO Project 25 Steering Committee Thursday, August 12, 1994

1 INTRODUCTION

The objectives of this effort to establish a standards profile for the operations and functionality of new digital Public Safety radio systems are as follows.

1. Obtain maximum radio spectrum efficiency.

2. Ensure competition in system life cycle procurement.

3. Allow effective, efficient and reliable intra-agency and interagency communications.

4. Provide "user friendly" equipment, "user friendly" being defined as the least amount of mental and physical interaction by the operator.

2 GENERAL REQUIREMENTS LIST

In order to meet the stated objectives, it is felt that a general list of requirements is needed that defines the necessary system characteristics. This general list of requirements serves as a guideline for the more comprehensive list of detailed requirements which follows. To support this, the following statements are set forth as provided by Public Safety users with some modification.

1. The system shall offer channel utilization that immediately improves spectrum efficiency by at least two (2) times[1] over current analog systems, with a goal of an increase in improvement to at least four (4) times as technology continues to develop.

2. Subscriber units shall communicate in either a conventional or trunked environment using clear (un-encrypted digital), digitally encrypted voice, or data modes regardless of the manufacturer of the equipment.

3. The system shall provide up to four levels of encryption with compatible modes of operation and shall provide the same functions associated with clear (un-encrypted digital) operation.
   Subscriber units shall be capable of zero, one or two types of encryption, as required.

   Type 1 is for classified national government communication.
   Type 2 is for unclassified national security-related communications.
   Type 3 is for unclassified sensitive government communications (e.g., Public Safety).
   Type 4 is for other purposes, (e.g., exportable).

4. Multiple radio subsystems must be interconnectable into larger systems. Further, subscriber unit units must be able to roam between different radio subsystems. Up to 64,000 different radio subsystems shall be uniquely identifiable. Further, each radio

[1] Public Safety Frequencies 821-824/866-869 MHz presently use enhanced 25 kHz channel equipment together with a 12.5 kHz / 25 kHz regional coordination plan tied to minimum spacings between base stations. In this instance,. the improvement in spectrum efficiency with 12.5 kHz digital channels will be approximately 1.3 times.

subsystem shall provide for up to 2,000 uniquely identifiable functional talk-groups or vertical partitions for distinct and separate organizations, and at least 48,000 individually identifiable subscriber units. Through hierarchical numbering, individual subscriber units and talk-groups from any radio subsystem are uniquely identifiable in any radio subsystem in concert with their home subsystem identification (similar to hierarchical telephone numbers and area codes).

5. The system shall be designed around a suite of operational standards so that field systems manufactured by different vendors can operate together and offer unit-to-unit communications based on predefined activation procedures.

6. Data transmission between a public or private switched telephone network access point, standard SNA, X.25, or TCP/IP networks and mobile (or portable) Data Terminal Equipment (DTE), over the RF link, are required. Data transmission shall operate at a speed of at least 9600 bps (including overhead) with minimal error retransmissions. All host applications on SNA, X.25, or TCP/IP networks shall have the ability to identify, and transparently communicate with any subscriber unit linked DTE device.

7. All subsystems which comprise a radio system must be under control of a single network management scheme, regardless of manufacturer. The scope of the single network management scheme includes the five basic elements of network management:

    a. Configuration Management
    b. Fault Management
    c. Security Management
    d. Performance Management
    e. Accounting Management

Implicit in the ability to manage these elements is the transfer of relevant managed object attributes which can be used for example to generate;

Managed information reports, alarms, reconfiguration, etc.

8. Management of system components and software levels shall be able to be performed from a single point.

9. Overall system management shall be able to delegate vertical partitioning management to the organization responsible for the operation of the partition.

10. Voice quality for both clear and encrypted communication shall be equal to or superior to current clear voice analog systems and the measure of quality shall include both male and female voices.

11. System range performance for both clear and encrypted communication shall be equal to or superior to current clear voice analog systems and shall include simulcast without the need for additional site development.

12. The system shall meet all the mandatory requirements and shall offer as options the same desirable features as APCO Project 16A. In all instances where APCO Project 25 Statement of Requirements conflicts with those of APCO Project 16A, the APCO Project 25 Requirements shall supersede.

13. Equipment size shall be comparable to existing analog systems. Portable subscriber units shall be offered for covert and uniformed users (covert portable being smaller) with batteries that shall power these portables for at least 8 hours (5,5,90 duty cycle) with

minimal size and weight.

14. Interconnection to public switched telephone network shall be equal to or superior to current analog systems.

15. Each manufacturer's system shall provide for backward compatibility with that manufacturer's existing analog systems to facilitate a graceful and gradual migration from the old analog to the new digital. As a minimum, this shall include mobile and portable subscriber units. In addition, subscriber units shall include the ability to select and operate on available analog mutual aid channels for communications with the fixed network equipment as well as direct unit-to-unit.

16. The system shall be able to co-exist with older analog systems, share the same segments of allocated RF spectrum and provide little interference to existing adjacent-channel analog systems as well as work properly.

17. The system shall be technically flexible to allow for single and multiple site systems, voting and simulcast designs, with variable numbers of stations per site. The system shall allow for single station sites without loss of control, voice, or text capability. The maximum number of stations at a site shall not be limited for future growth.

18. The system shall allow for continued enhancement of standardized functions and features so that the system can grow with user needs. Further, a standard method shall be specified for segmenting non-standard (or potentially future-standard), value-added features between manufacturers to safeguard from unintentional interaction between subscriber units of different manufacturers subsystems.

19. The system shall minimally be equally adaptive to all Public Safety mobile radio frequency bands and blocks of spectrum, without precluding its adapting to other land mobile bands.

20. The mobile and portable equipment shall meet the applicable sections of MIL-STD-810D "Environmental Test Methods and Engineering Guide" as follows.

    506.2 Rain, Procedure I (blowing rain)
    509.2 Salt Fog, Procedure I (aggravated screening)
    510.2 Sand and Dust, Procedure I (blowing dust)
    514.3 Vibration, Procedure I, Category 1 (3 axes)
    516.3 Shock, Procedure I (functional)

21. Throughput delay shall be as follows:

    a. Less than 250 msec in direct radio-to-radio communications.
    b. Less than 350 msec in radio-to-radio communications through a single conventional repeater.
    c. Less than 500 msec in radio-to-radio communications within an RF subsystem.

22. The system shall be designed to be resistant to interference from co-channel, adjacent-channel, and intermodulation effects similar to Continuous Tone-Controlled Squelch Systems (CTCSS) used today.

23. The system shall allow direct mobile to mobile communication at any time without degrading normal system performance. Direct communication while in range of the fixed

equipment shall do no more than temporarily capture receivers from possible outbound messages. Direct communication shall be possible at any time while out of range of the fixed equipment with no degradation in system performance or capacity.

24. A dispatcher shall have the ability to interrupt any call enabled by the system that an individual may be engaged in.

25. The mobile and portable equipment shall be able to scan both conventional channels (at least 8) and trunked talk-groups (at least 8) in both clear and encrypted voice. The scan to be completed in the minimum time. The scan shall be selectable priority which means that the transmitter channel or talk-group selected by the user is the priority channel or talk-group.

26. The system shall have over-the-air-re-keying (OTAR) of encryption keys.

27. The system shall allow mobiles and portables to roam over a wide coverage area with automatic connection as the unit enters a new site coverage area within any radio subsystem. The system must provide for registration and authorization control over subscriber units roaming between radio subsystems. Manual and automatic roaming capabilities shall be provided between radio subsystems.

28. The system shall allocate channels at sites based upon subscriber units present which need to receive a given message.

29. A manufacturer of an APCO 25 software product should define the extent of the operating environment over which the product is known to work.

3 DETAILED REQUIREMENTS LIST

In order to meet the above stated general requirements list, it is felt that a detailed list of requirements is needed that defines the necessary system characteristics and services. The general rule for these detailed requirements is that they stem from one or more of the general requirements. To support this, the following requirements are recommended.

.1 System Requirements

a. The system shall support existing 25 kHz and 12.5 kHz channelization where already established. Within 25 kHz channelization and where permitted, the system shall support operation on 2-for-1 12.5 kHz channelization. All protocols and procedures shall be adaptable to further channel splits as technology permits.

b. Systems or subsystems shall be configured in single site, multiple site non-simulcast, or multiple site simulcast. Multiple RF subsystems shall be combinable into larger wide-area systems. Wide-area systems shall be composed of individual RF subsystems which are independently capable of single site, multiple site, or multiple site simulcast. Any individual site need only deploy as many stations as necessary except in RF simulcast subsystems.

c. Systems shall support authorized roamers from compatible digital systems for interagency assistance.

d. All calls shall be digital except compatible analog voice calls.

e. The site (or simulcast RF subsystem) location of all subscriber units, including authorized roamers, shall be maintained by the system.

f. Calls shall not require resources at sites that do not contain addressed subscriber units (except simulcast RF subsystems).

g. RF subsystems shall contain all the control intelligence to support call processing and track unit location and roamers within the RF subsystem. All RF subsystems shall support standard signalling and communications interfaces to be flexibly linked into wider-area networks via private or public networks.

h. RF subsystems from any manufacturer (as described in C.1.g.) must be interconnectable into a wide-area system.

i. Signaling format(s) must be compatible with standard transmission facilities in accordance with the North American transmission standards as defined by Bellcore TR-TSY-000333 for Switched and Special Access Services.

.2 RF Subsystem Interfaces

a. An RF subsystem shall support either analog or ISDN standard fixed-network PSTN interfaces for telephone interconnect.

b. An RF subsystem shall support a fixed-network host computer interface or an X.25, SNA, or TCP/IP network interface.

c. An RF subsystem shall support standard network management interfaces to

other RF subsystems of any manufacturer.

d. An RF subsystem shall support standard service signalling and bearer channel interface for interconnection with other RF subsystems by a public or private wide-area network. The standard service set between RF subsystems shall be composed of the following.

(1) group calls setup
(2) private calls setup
(3) voice encryption control
(4) RF subsystem registration (roaming)
(5) analog bearer channel
(6) digital bearer channel
(7) access control and security

.3 Common Air Interface Requirements

a. One channel bit-rate, modulation, and link layer shall be utilized for all voice and data capabilities, excepted only for manufacturer-specific subsystems to provide backwards compatibility to existing manufacturer-specific systems.

b. For single channel operation, control, voice, or data, features must be integrated into a common channel.

c. A standard service set for all manufacturers composed of the following.

(1) group calls
(2) private calls
(3) interconnect calls
(4) voice encryption control
(5) data messages
(6) site registration
(7) RF subsystem registration (roaming)
(8) dynamic subscriber unit talk-group regrouping
(9) emergency alarm
(10) User ID

.4 Mobile/Portable Subscriber unit Requirements

a. Support all digital communications within this system.

b. Support analog communications within this system when involved in a call from an analog unit.

c. Support analog communications on a conventional channel.

d. Support a data port to an attached MDT (mobile data terminal), portable computer or other peripheral device.

4 STANDARDS SUITE PROPOSED

In order to meet the stated objectives and requirements, it is felt that a comprehensive suite of standards is necessary that defines the interface characteristics and permits the interconnection of all system components. The necessary standards components are as follows.

.1 Bandwidth

Adopt 12.5 kHz bandwidth channels with future migration to 6.25 kHz bandwidth channels as technology allows.

.2 FS-1024

Adopt work done under FS-1024 project (Narrowband Digital Land Mobile Radio) as much as possible to ensure vendor competition and interoperability.

.3 Interface

a. Establish a Common Air Interface all-digital trunking control standard, voice and data standard, and a control standard.

b. Adopt an RF subsystem Interface Standard for the connections between all RF subsystems from international, national or industry standards as appropriate and available. Such standards sources as CCITT shall be consulted, among others.

.4 Host Interface Standard

The mobile data terminal (MDT) interface must be able to present an addressable MDT data stream to a host-attached port, physically over either an RS-232 or V.35 electrical interface, using either analog or digital transmission public switched telephone network (PSTN) facilities, or a computer network. When connected to a computer network, each MDT must be individually provided with its own network address, with such network presentation conforming to layers 1 through 3 of the OSI model according to the following specifications.

a. 1984 CCITT Recommendation X.25. The physical layer must be capable of conforming with EIA RS-232-C for data rates under 19.2 kbps and CCITT V.35 for data rates above 19.2 kbps. The link layer must be compliant with High-level Data Link Control (HDLC) Link Access Procedure Balanced (LAPB).

b. IBM System Network Architecture (SNA) using Physical Unit (PU) 2 to PU 4 with Logical Unit (LU) 2 and LU 3. The physical layer is as specified in item D.1., above. The link layer must be compliant with Synchronous Data-Link Control (SDLC).

.5 Encryption Standard

a. Adopt FIPS 46 DES (Data Encryption Standard) to ensure vendor competition and interoperability.